

What is claimed is:

1. A multifunctional microcapsule comprising:
a core material, the core material including a major portion of a first additive; and
a shell material, the shell material incorporating a minor portion of a second additive.
2. A multifunctional microcapsule according to claim 1, wherein:
the first additive includes a flame retardant; and
the second additive is selected from a group consisting of flame resistance agents, smoke suppressants, infrared attenuation agents, flame spread reducing agents, thermal conductivity modifying agents, thermal stability agents and termite resistance agents.
3. A multifunctional microcapsule according to claim 2, wherein:
the first additive accounts for at least 80 weight percent of the core material; and
the second additive accounts for no more than 20 weight percent of the shell material.
4. A multifunctional microcapsule according to claim 3, wherein:
the first additive accounts for at least 90 weight percent of the core material; and
the second additive accounts for no more than 10 weight percent of the shell material.
5. A method of forming multifunctional microcapsules comprising:
distributing a core material in a fluid;
distributing a shell material and a shell additive in the fluid; and
modifying at least one property of the fluid to a degree sufficient to cause the shell material and the shell additive to combine in a shell layer

surrounding the core material, thereby producing a plurality of microcapsules.

6. A method of forming multifunctional microcapsules according to claim 5, wherein:

the core material is distributed within the fluid as a suspension or an emulsion;

the shell material is distributed within the fluid to form a solution or an emulsion; and

the pH of the solution is increased to induce coacervation of the shell material at a boundary between the core material and the fluid.

7. A method of forming multifunctional microcapsules according to claim 6, wherein:

the core material is a flame retardant and is suspended in water;

the shell material is selected from a group consisting of polyolefins, polyurethanes, polyesters, polyethylene terephthalates, polyvinyl chlorides, and melamine formaldehyde resins and the shell additive is zinc borate or a nucleating agent; and

the core material accounts for at least 80 weight percent of the microcapsules.

8. A method of forming a multifunctional microcapsule according to claim 7, wherein:

the flame retardant is HBCD;

the shell material is a polyurethane; and

the shell additive is zinc borate.

9. A method of forming a multifunctional microcapsule according to claim 7, wherein:

the microcapsules have a median diameter of less than 10 μm .

10. A method of forming a multifunctional microcapsule according to claim 9, wherein:

the microcapsules have a median diameter of less than 5 μm .

11. A method of forming a multifunctional microcapsule according to claim 10, wherein:

at least 70 weight percent of the microcapsules have a median diameter of less than 5 μm .

12. A method of forming a multifunctional microcapsule according to claim 5, wherein:

the microcapsules release the core material at a decomposition temperature, the decomposition temperature being at least 250 $^{\circ}\text{C}$.

13. A method of forming a multifunctional microcapsule according to claim 12, wherein:

the decomposition temperature is at least 350 $^{\circ}\text{C}$.

14. A polymeric foam comprising:

a polymeric matrix; and

a plurality of multifunctional microcapsules, the microcapsules including a functional core material surrounded by a layer of a functional shell composition.

15. A polymeric foam according to claim 14, wherein:

the functional core material includes a flame retardant; and

the functional shell material includes a major polymeric component and a minor functional additive component.

16. A polymeric foam according to claim 14, wherein:

the polymeric foam includes a polystyrene; and

the microcapsules have a median diameter of less than 5 μm .

17. A polymeric foam according to claim 14, wherein:
the major polymeric component includes one or more materials selected from a group consisting of melamine formaldehyde, polyvinyl alcohol, polyester and polycarbonate; and
the minor functional additive component includes one or more materials selected from a group consisting of fire retardants, flame suppressors, conductivity modifiers, thermal stabilizers and insecticides.
18. A polymeric foam according to claim 14, wherein:
the flame retardant includes one or more materials selected from a group consisting of HBCD, DCP, BE-51 and TPP; and
the major polymeric component includes melamine formaldehyde and the minor functional additive component includes zinc borate.
19. A polymeric foam according to claim 14, wherein:
the microcapsules account for between about 0.25 and about 10 weight percent of the polymeric foam; and
the microcapsules have a median diameter no larger than about 5 microns.
20. A polymeric foam according to claim 14, wherein:
the flame retardant includes one or more materials selected from a group consisting of HBCD, DCP, BE-51 and TPP; and
the major polymeric component includes a polyurethane and the minor functional additive component includes zinc borate.